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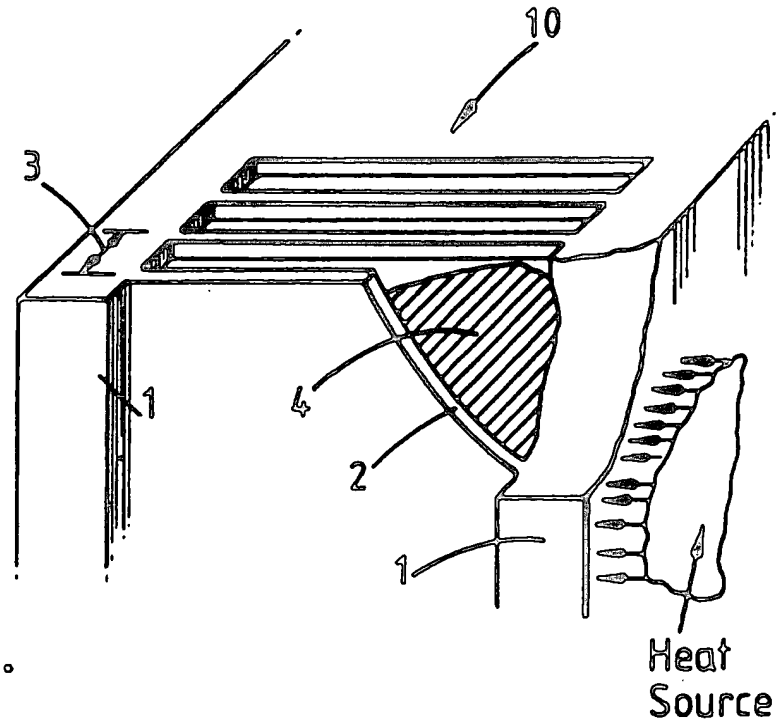
(57) Abstract

A heat sink (10) is formed by an aluminium framework composed of thick walls (1) interconnected by thin fins (2). The fins (2) are about 0.10 to 0.20 mm in thickness and are spaced apart by about 0.5 mm to 1.5 mm so as to form cells (4). The cells (4) are filled with a wax.



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HEAT SINK

This invention relates to heat sinks particularly for use with devices, typically electrical or electronic devices for dissipating heat generated by such devices.

Various forms of heat sinks are well known some of which comprise a metal structure having an extended surface area which is exposed to a current of air or liquid as the heat dissipating medium. The air current may be by natural convection or may be fan generated. The liquid may be pumped. Another known form of heat sink, which may also be force cooled, has the metal structure in the form of a framework forming a plurality of cells each housing a body of wax. The wax absorbs heat delivered to one of the metal walls of the framework firstly by temperature increase and then by phase change, from solid to liquid, which is equivalent to a temperature rise of about 150°C.

It is an object of the present invention to provide a new and improved form of heat sink.

According to the present invention there is provided a heat sink comprising a unitary metal framework made of highly thermally-conductive metal, having a pair of metal walls extending substantially parallel to each other and held in spaced mutual relationship by a plurality of metal fins, the fins being substantially parallel to each other and extending transversely to the metal walls, the arrangement being such that the framework defines a plurality of cells between adjacent fins, the cells being substantially filled with a fill material of low thermal conductivity and high latent heat of fusion, characterised by selecting the following features in combination:

i) the metal is aluminium;

ii) the fins have a thickness in the range 0.10 to 0.20 mm;

iii) the spacing between the fins is in the range 0.5 to 1.5 mm;

iv) the fill material is a wax.

By virtue of the present invention the effective thermal resistance of the heat sink is very low, significantly lower than hitherto which results in the temperature of the metal wall input face being maintained at a comparatively low temperature, typically not more than 5°C greater than the temperature at which the wax fill material melts, until the entirety of the wax fill material has melted. Thus there is highly efficient removal of heat from the heat source and forced cooling of the heat sink is not required. Additionally, the heat sink is comparatively small in size and weight.

It will be understood that the wax fill material may be any one of a number of different waxes having different melt temperatures and latent heat of fusion. Particular waxes may be selected for any particular application of the heat sink, for example from the data listed in the "Handbook of Chemistry and Physics" published from time to time by CRC Press, Inc. (for example, the 65th edition published in 1984/5). The waxes may be long-chain hydrocarbons or silicone based materials. They are selected because they are inexpensive and non-toxic, usually with a melting temperature below 150°C. Also, they have comparatively low thermal conductivity.

An embodiment of the present invention will now be described by way of example with reference to the accompany diagrammatic drawing.

The drawing shows a heat sink 10 comprising a unitary metal framework made of aluminium which is a highly thermally-conductive metal. The framework is formed of a pair of substantially parallel walls 1 which are comparatively thick and which are interconnected and held in spaced mutual relationship by a plurality of spaced fins 2 which are comparatively thin. The fins 2 are substantially parallel to each other and extend transversely, preferably orthogonally, to the walls 1. The spaces between adjacent fins 2 and bonded by the walls 1 define cells 4 which are substantially filled with wax

material of low thermal conductivity and high latent heat of fusion.

The fins 2 are about 0.15 mm thick and have a pitch or spacing 3 which is less than 1.5 mm and for example 0.65mm. The walls 1 are typically 0.4mm in thickness and are spaced apart typically by about 5 to 10mm although this is not critical. The wax may for example be Naphthalene 1,7-dichloro which has a melting point of about 63°C and a latent heat of fusion of about 250 KJ/kg.

In use, one of the metal walls 1 forms the heat input face of the heat sink 10 and is placed in intimate contact with a device which is to be cooled. Because the aluminium is highly thermally conductive heat is rapidly transferred by conduction to each of the fins 2. The fins 2 are both thin and closely spaced so that there is a very large increase in surface area of fins and wax. The thickness of each wax filled cell 4 is comparatively small so that the thermal path length to the centre of each cell 4 is comparatively small and accordingly the thermal resistance of the sink 10 is comparatively low notwithstanding the low thermal conductivity of the wax. This results in the temperature of the heat input face 1 being held at not more than about 68°C which is only 5°C more than the temperature at which the wax melts until such time as the entirety of the wax has melted. Heat dissipation is therefore highly efficient without any requirement to have forced cooling or large exposed surface areas with fin pitches typically greater than 2mm suitable for natural or forced convection.

Claims

1 A heat sink comprising a unitary metal framework made of highly thermally-conductive metal, having a pair of metal walls (1) extending substantially parallel to each other and held in spaced mutual relationship by a plurality of metal fins (2), the fins (2) being substantially parallel to each other and extending transversely to the metal walls (1), the arrangement being such that the framework defines a plurality of cells (4) between adjacent fins, the cells being substantially filled with a fill material of low thermal conductivity and high latent heat of fusion, characterised by selecting the following features in combination:

i) the metal is aluminium;

ii) the fins have a thickness in the range 0.10 to 0.20 mm;

iii) the spacing between the fins is in the range 0.5 to 1.5 mm;

iv) the fill material is a wax.

2 A heat sink as claimed in Claim 1, wherein the walls (1) are about 0.4mm in thickness and are spaced apart by a distance in the range 5 to 10mm.

3 A heat sink as claimed in Claim 1 and substantially as hereinbefore described with reference to the accompanying drawing.

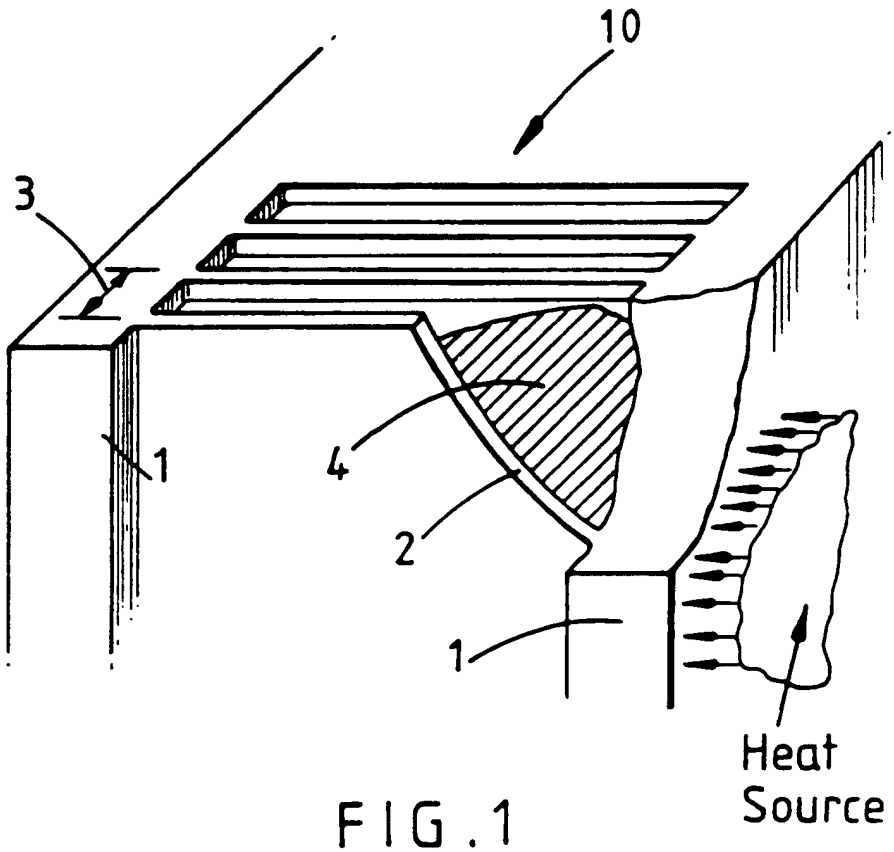

FIG.1

INTERNATIONAL SEARCH REPORT

Inter al Application No
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A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01L F28D F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,3 215 194 (J.H. SUNUNU ET AL) 2 November 1965 see the whole document ---	1
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